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ECE 637
Exam #1

4 $M(x,t) = M_o + G(t)x$

4.1) $\boxed{\omega(x,t) = \gamma(M_o + G(t)x)}$

4.2) $\phi(x,t) = \int_0^t \gamma M(x,\tau)\,d\tau = \int_0^t \gamma(M_o + G(\tau)x)\,d\tau = \int_0^t \gamma M_o + \gamma G(\tau)x \; d\tau$

$= \omega_o t + x k_x(t) + \cancel{C}^{\,0} \; ; \quad \omega_o = \gamma M_o, \quad k_x(t) = \int_0^t \gamma G(\tau)\,d\tau$

$\phi(x,0) = 0$

$= \boxed{\omega_o t + x k_x(t) \; ; \quad \omega_o = \gamma M_o, \quad k_x(t) = \int_0^t \gamma G(\tau)\,d\tau}$

4.3) $r(x,t) = a(x) e^{j\phi(x,t)}$

$= a(x) e^{j(\omega_o t + x k_x(t))}$

$= \boxed{a(x) e^{j\omega_o t} e^{j x k_x(t)}}$

4.4) $r(t) = \int_R r(x,t)\,dx$

$= \int_R a(x) e^{j\omega_o t} e^{j x k_x(t)} \, dx$

$= \boxed{e^{j\omega_o t} \int_R a(x) e^{j x k_x(t)} \, dx}$

- Design RF pulse to excite protons in single slice
  - Turn off x and y gradients, i.e. $G_x = G_y = 0$.
  - Set z gradient to fix positive value, $G_z > 0$.
  - Use the fact that resonance frequency is given by

$$\omega = L(M_o + zG_z) \; .$$

4.5)